

Status of the Megha-Tropiques mission

Precipitation related activities



Outline of the presentation

1) The mission

- Status
- Operational application: assimilation

2) Science Application of the TAPEER 1.5 product

- Hydrology
- Extreme

3) New developments using GPROF and PRPS

- TAPEER 2.0

4) Conclusions and Perspectives

The Megha-Tropiques mission

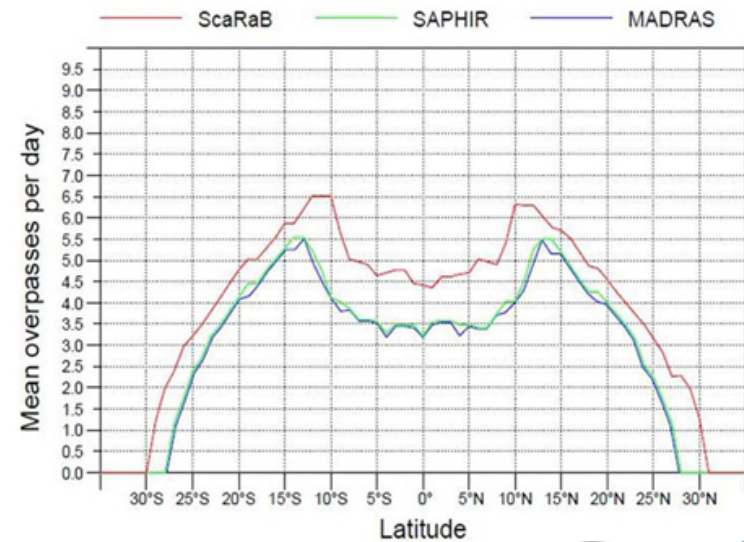


- Indo-French Mission built by ISRO and CNES launched in October 2011
- dedicated to the monitoring of the water and energy cycle in the tropics
- Orbit with 20° inclination on the equator
- Nominal life: 3 years + 2 years extension + 4 years phase 2 up to 2020

Megha means « Cloud » in sanskrit



Courtesy CNES



- A mission at the heart of WCRP
- Partner of the GPM constellation

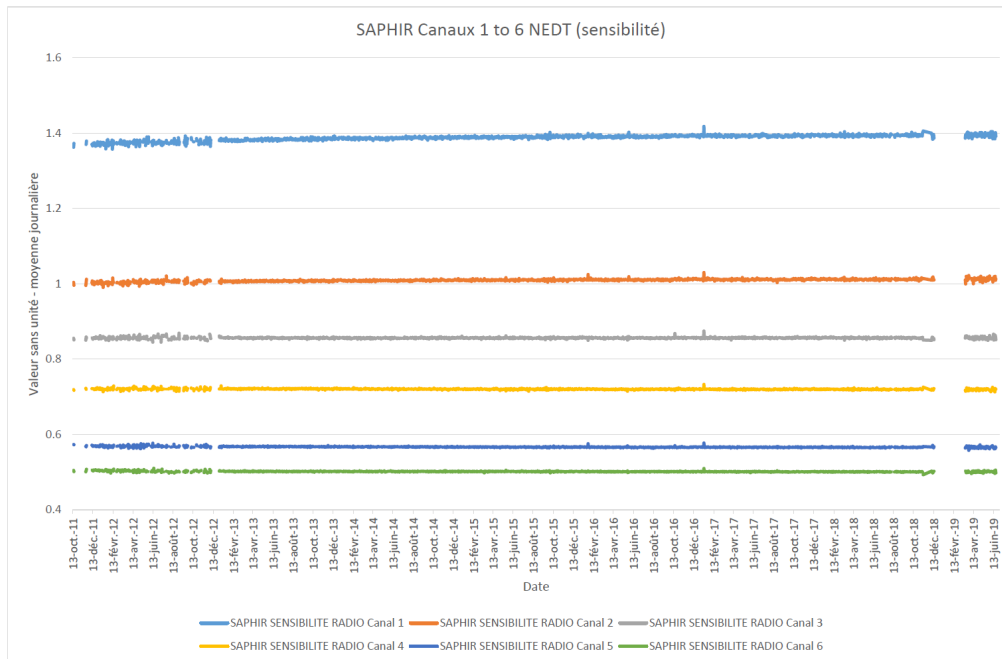
GEWEX



The Megha-Tropiques mission

8th year of operation completed last October

Our 183 GHz, 6 channels radiometer, SAPHIR, is working nominally



Problems on the platform from Dec 2018 to March 2019

Degraded Mode Since ~April 1st 2019

1 orbit out of 3 to control the temperature of the internal memory : ~25-30% of the data

Occasionally platform location issues : drift in nadir position
Only for NRT (past data are fixed)

The NRT stream is now at stake. If needed to GPM science team, please email me !

Megha-Tropiques : operational applications

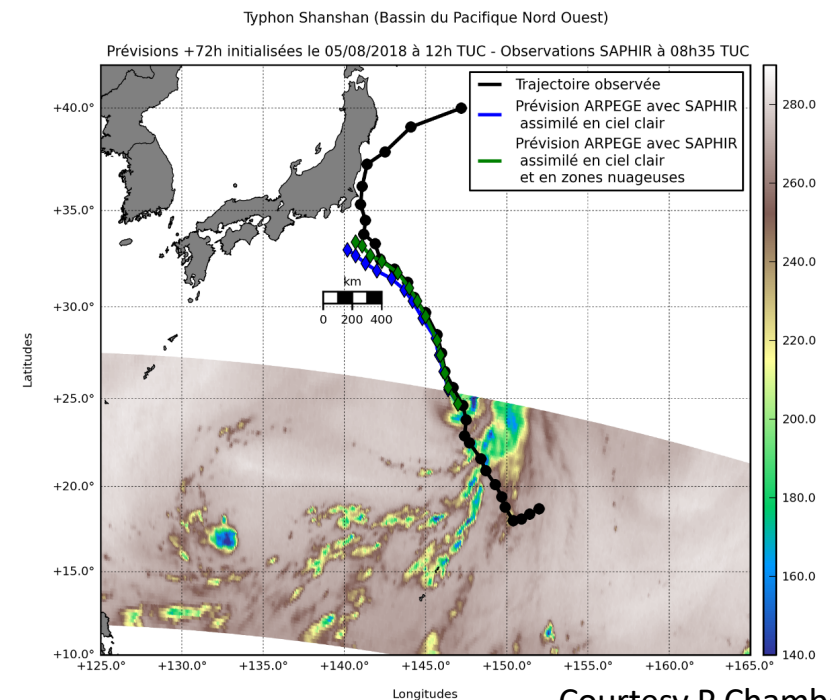
Up to the beginning of the degraded mode,

| NWP center | Observations | Reference |
|---|-------------------|--|
| ECMWF | Clear & total sky | Chambon et Geer (2017) |
| Fleet Numerical Meteorology and Oceanography Center (FNMOC) – U.S. Navy | Clear sky | Jones et al. (2017) Karpowicz et al. (2017) |
| Japanese Meteorological Agency (JMA) | Clear sky | |
| Joined Center for Satellite Data Assimilation (JCSDA) | Clear sky | Jones et al. (2017) |
| Korean Meteorological Administration | Clear sky | Lee et al. (2018) |
| Météo-France | Clear Sky | Chambon et al. (2015) |
| National Center for Environmental Prediction (Ncep) | Clear sky | Jones et al. (2017) |
| Met Office | Clear sky | Doherty et al. (2018) |

Before the degraded mode 1 SAPHIR ~ 4 MHS

Degraded mode 1/3 of SAPHIR ~ 1.5 MHS

Research experiment with total sky assimilation

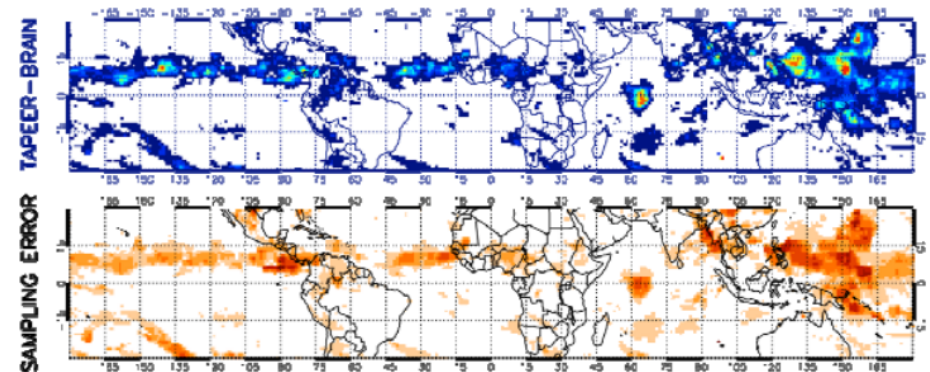


Courtesy P Chambon

The TAPEER 1.5 product

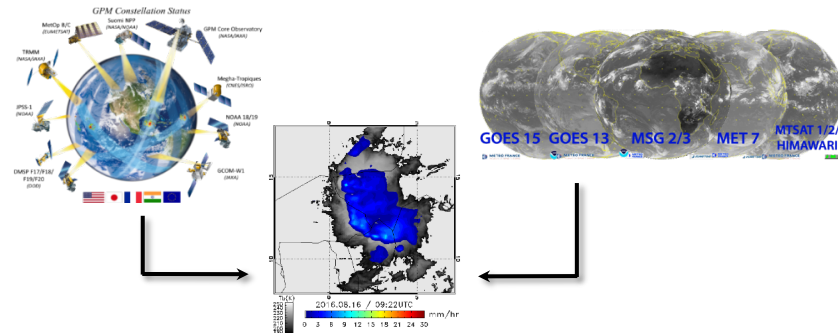


Tropical Amount of Precipitation with Estimation of Errors



1° 1 day resolution

NO RAIN GAUGES



The TAPEER Framework

Rain Accumulation over a given time [mm]

$$R = RCOND_BAR \times Precipitation_Fraction \times Time$$

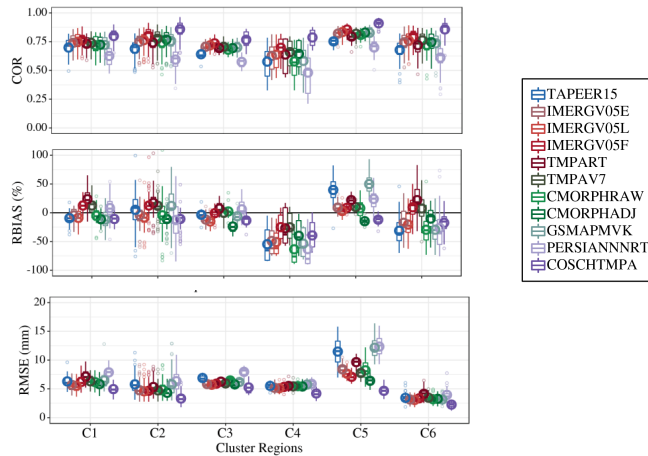
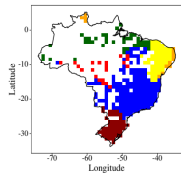
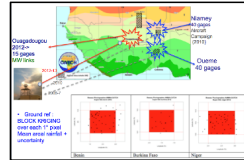
Conditional Rain Rates [mm/hr]
[PMW Rain Rate]

Fraction of precipitating clouds
[GEO IR Images]
+
[PMW Detection]

Time period [hours]
[Multitemporal]

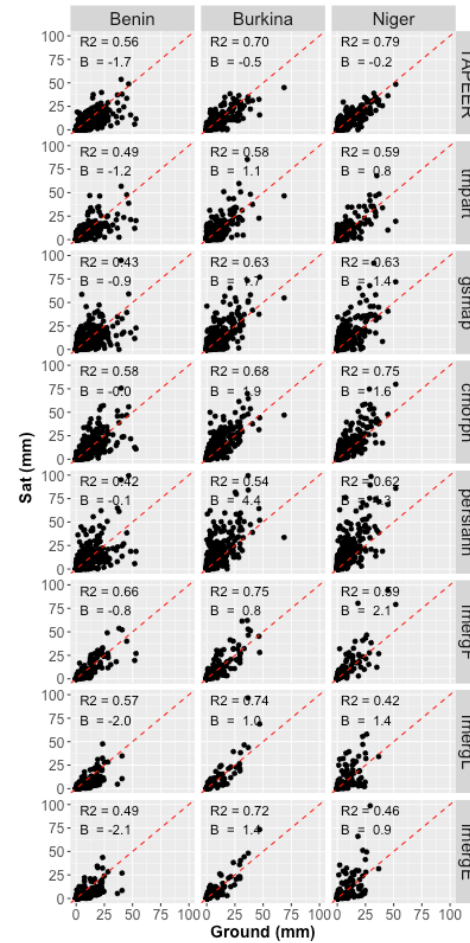
The TAPEER 1.5 product: performances

Gosset, M., Alcoba, M., Roca, R., Cloché, S. and Urbani, G.: Evaluation of TAPEER daily estimates and other GPM-era products against dense gauge networks in West Africa, analysing ground reference uncertainty, Q. J. R. Meteorol. Soc., 144, 255–269, doi:10.1002/qj.3335, 2018



Courtesy Rômulo A. Jucá Oliveira

More balanced performances over various climatological regions in Brazil



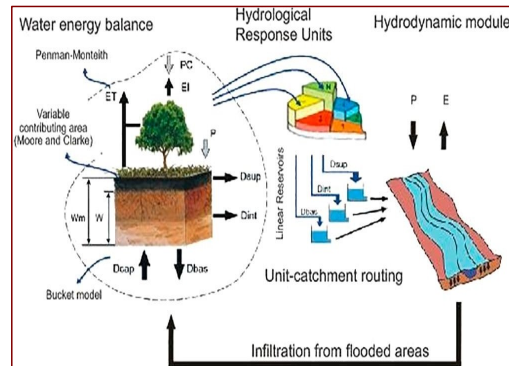
Very good performances against research ground based networks



The TAPEER 1.5 : hydrology applications (1/2)



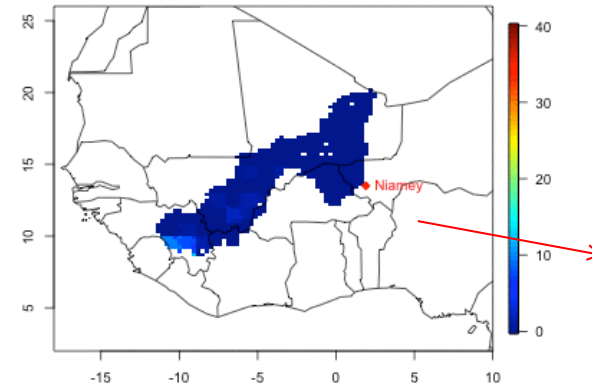
Niger Basin
4200 km
9 countries
Population :
130 million
to be doubled
in the next
50
years!!



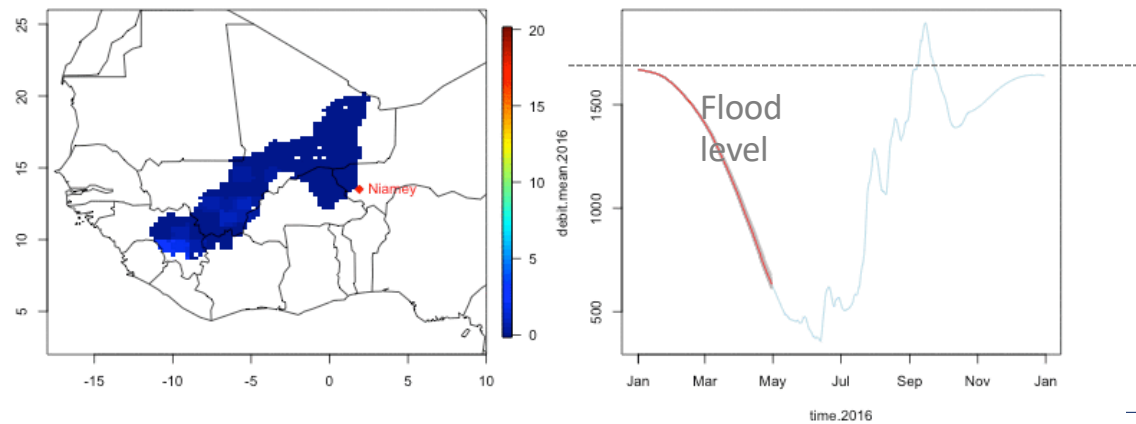
MGB model

Modèle Hydro MGB Niger :
Fleischman et al., 2018.

TAPEER Rain Niger Basin

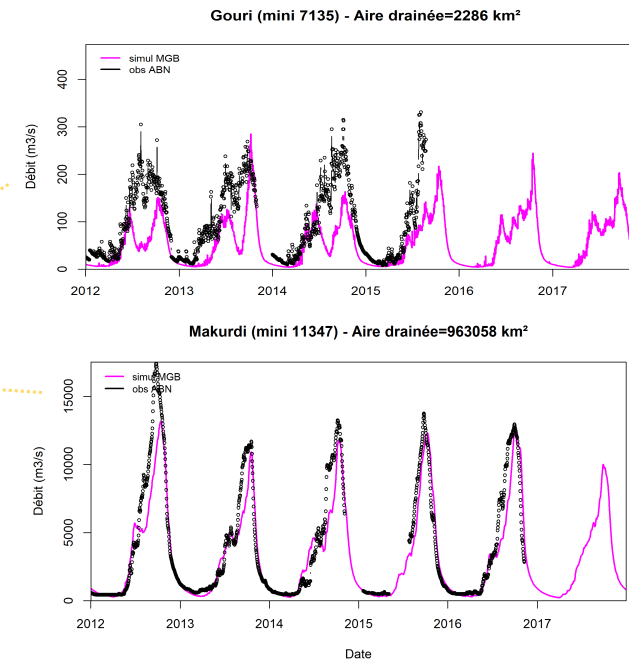
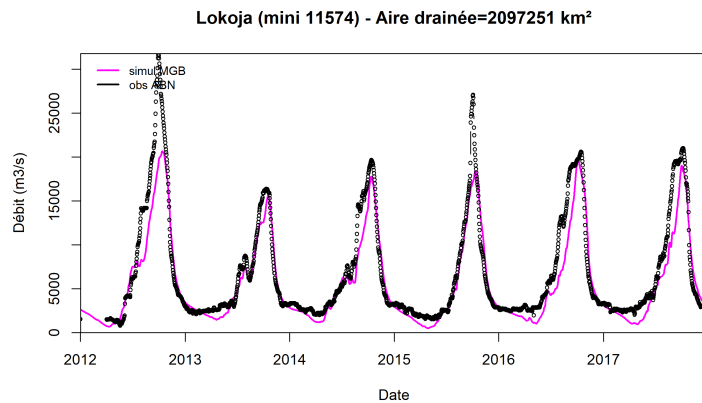
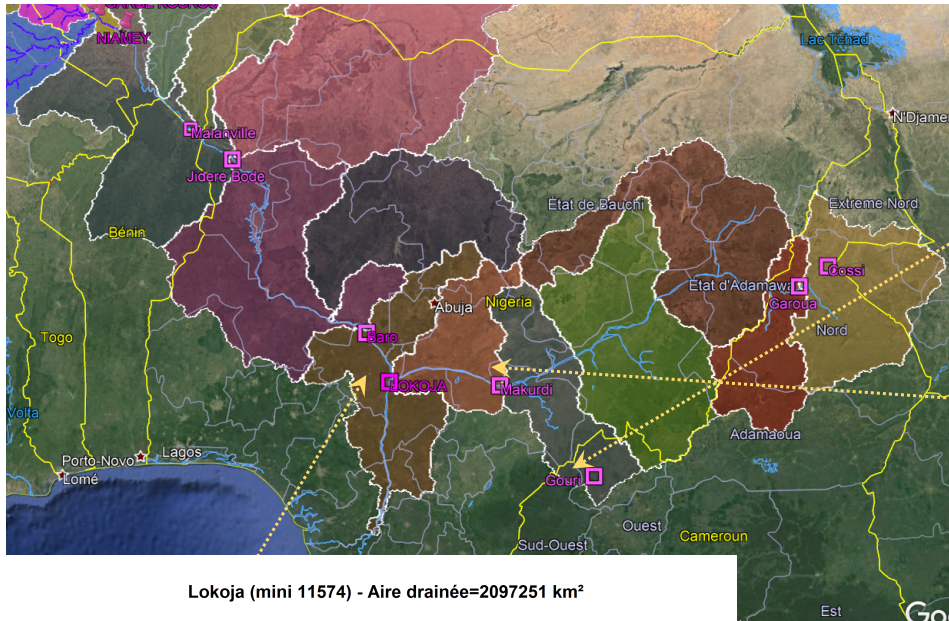


Niamey : discharge ensembles



Courtesy Marielle Gosset

The TAPEER 1.5: hydrology applications (2/2)

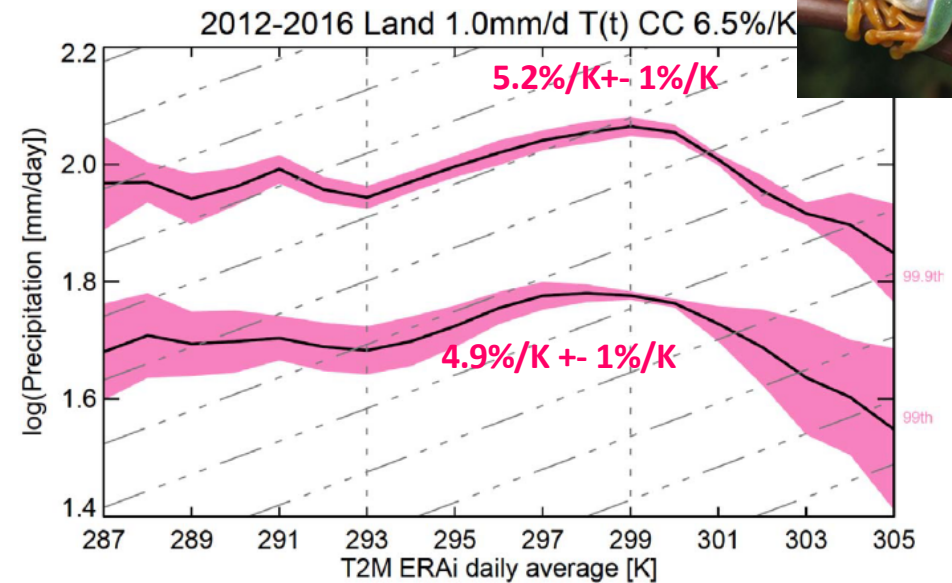
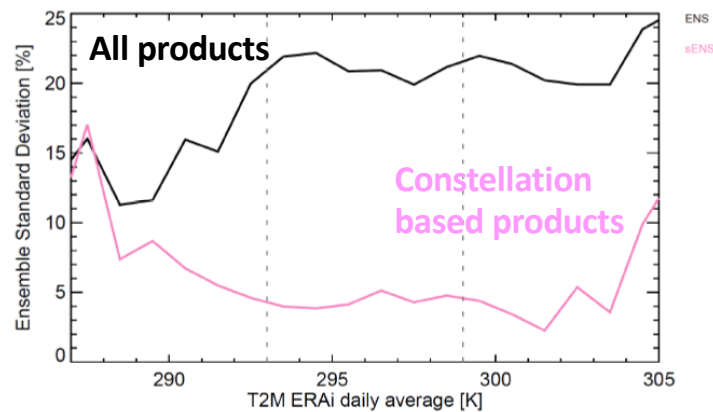
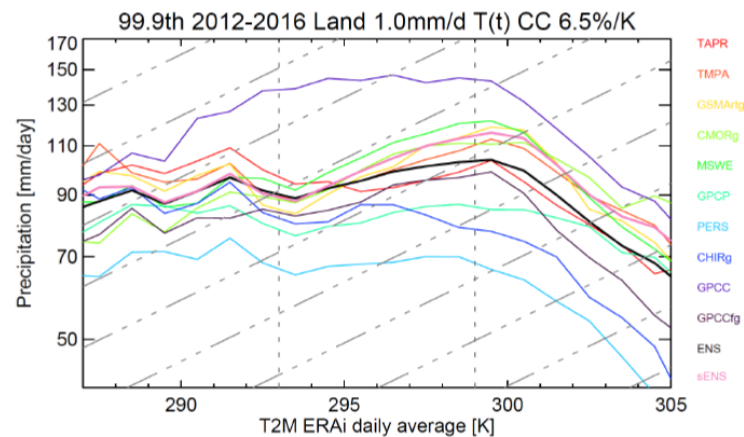


Difficulty upstream of the basin(station Gouri, bassin de tête), very good performances fort the Bénoué river and the confluence with (despite few data for calibration)

TAPEER 1°/1j data are fit to feed a hydrologigal model at large scale

Courtesy of Cécile Dardel and Marielle Gosset

Extreme precipitation and the constellation



Environmental Research Letters

ACCEPTED MANUSCRIPT • OPEN ACCESS

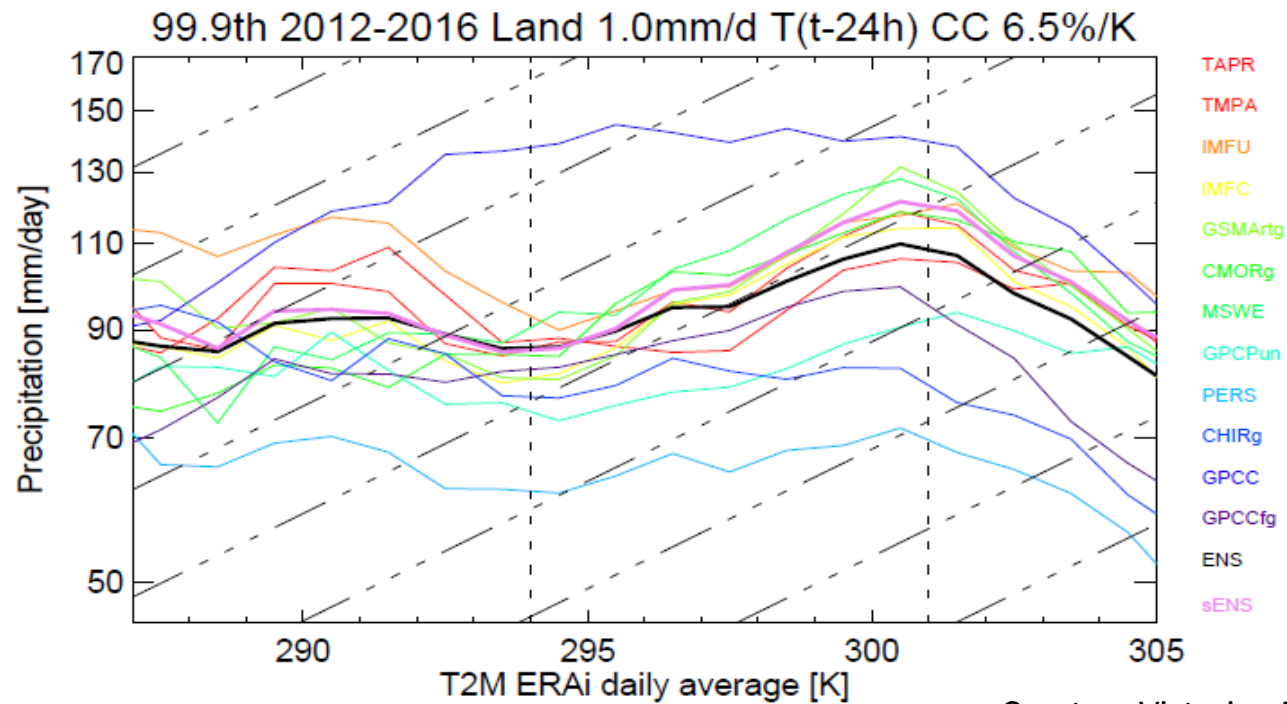
Estimation of extreme daily precipitation thermodynamic scaling using gridded satellite precipitation products over tropical land

Rémy Roca¹

Accepted Manuscript online 25 July 2019 • © 2019 The Author(s). Published by IOP Publishing Ltd

See FROGS DATABASE POSTER this afternoon

Extreme precipitation & the constellation: IMERG



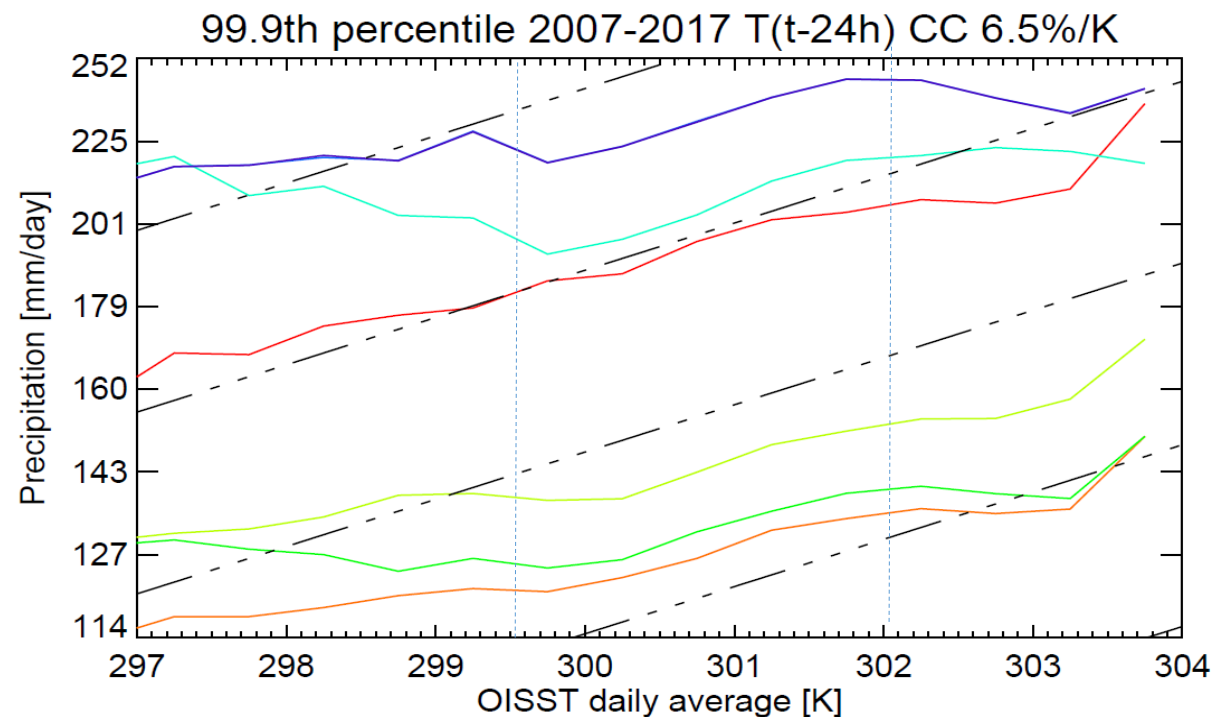
294K-301K

| | dp99.9/dSST |
|-------------|----------------|
| TAPR | 3.59556 |
| TMPA | 5.27531 |
| IMFU | 4.61493 |
| IMFC | 5.79453 |
| GSMArtg | 8.05661 |
| CMORg | 4.92103 |
| MSWE | 5.73754 |
| GPCPun | 3.54538 |
| PERS | 2.15641 |
| CHIRg | 0.861410 |
| GPCC | -0.0673090 |
| GPCCfg | 3.33241 |

Courtesy Victorien De Meyer

Extreme precipitation & the constellation: OCEAN

Work in progress



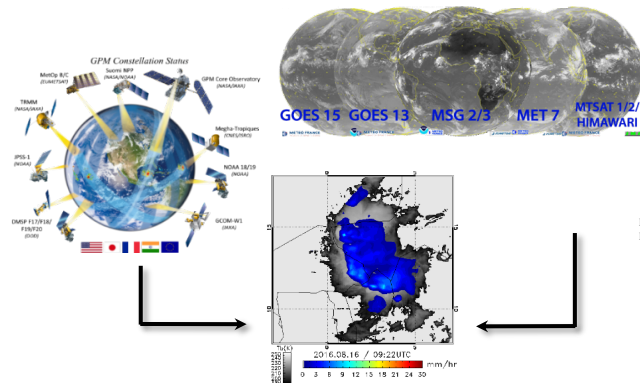
299.5K-
302.0K

dp99.9/dSST

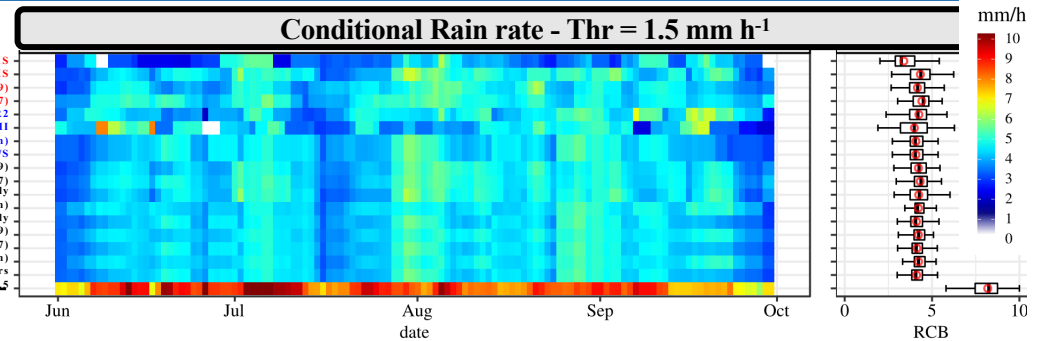
| | |
|-------------|-------------|
| GSMart | 5.25 |
| CMORg | 5.32 |
| MSWE | 5.30 |
| TMPA | 5.44 |
| HOAP | 6.75 |
| IMFU | 5.92 |
| IMFC | 5.95 |

Courtesy Victorien De Meyer

TAPEER 2.0



ATMS
MHS
SAPHIR (PRPS2019)
SAPHIR (PRPS2017)
AMSR2
GMI
SSM/I (15km)
SSM/US
Sounders W/ SAPHIR (PRPS2019)
Sounders W/ SAPHIR (PRPS2017)
Sounders only
Imagers only W/ SSM/I (15km)
Imagers only
Full Constellation W/ SAPHIR (PRPS2019)
Full Constellation W/ SAPHIR (PRPS2017)
Imagers & Sounders W/ SSM/I (15km)
Imagers & Sounders
TAPEER 1.5



The TAPEER Framework

→ GPM GPROF2017 &

→ PRPS2017 algorithms PRPS For SAPHIR

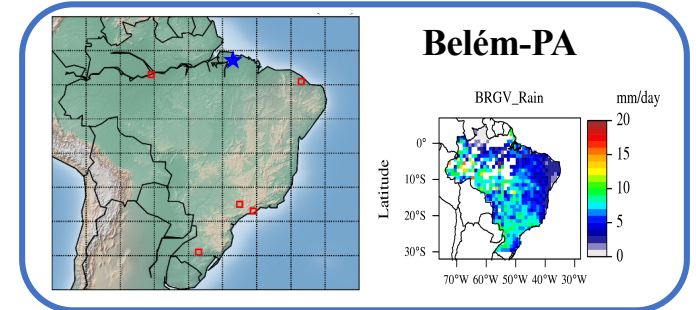
Rain Accumulation over a
given time [mm]

$$R = RCOND_BAR \times Precipitation_Fraction \times Time$$

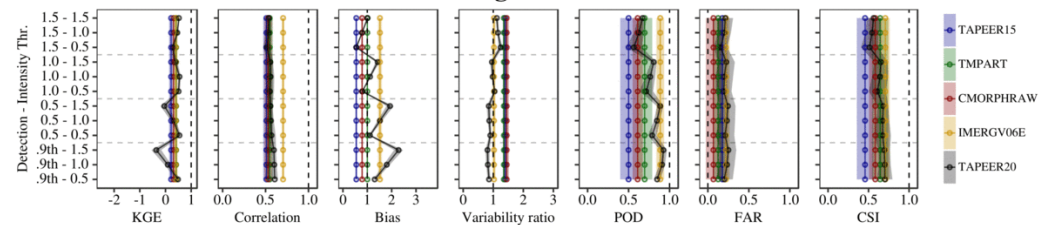
Conditional Rain
Rates [mm/hr]
[PMW Rain Rate]

Fraction of precipitating
clouds
[GEO IR Images]
+
[PMW Detection]

Time period
[hours]
[Multitemporal]



Imagers - BEL



Courtesy Rômulo A. Jucá Oliveira

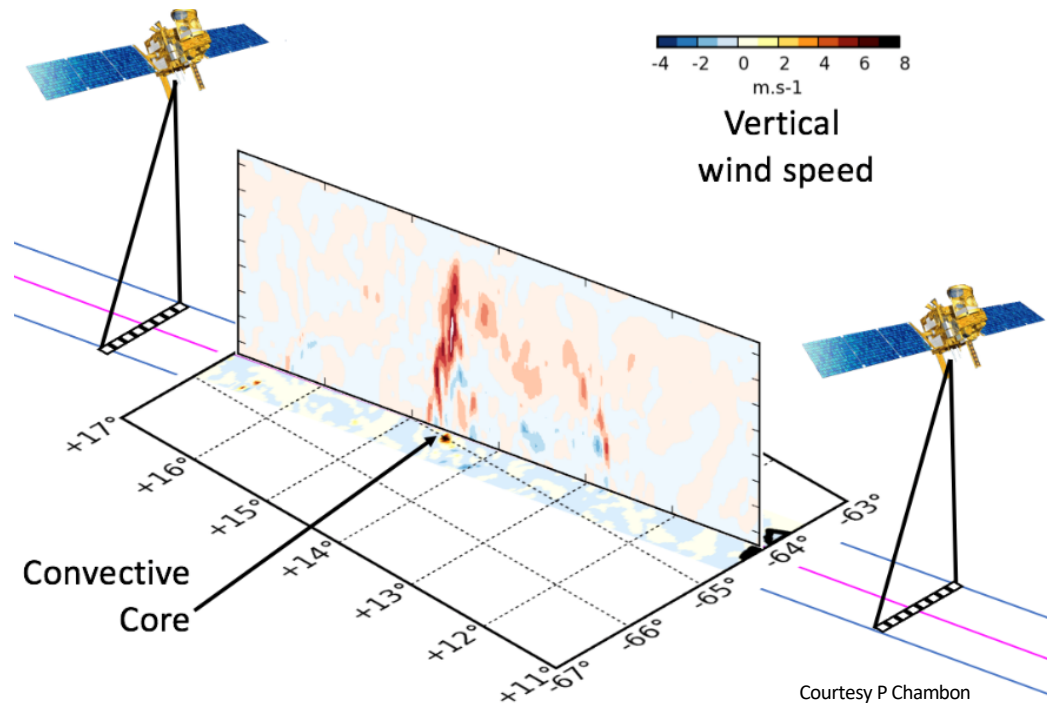
Perspectives

C₂OMODO Convective Core Observations through MicrOwave Derivatives in the trOpics

SAPHIR-NG

High frequency (> 183 GHz)
a few km resolution (<5km)
100km width
Polarization: TBD

Two platforms: 30s apart



Submitted to the CNES SPS 2019

Well received

Discussed in the NASA ACCP framework

Conclusions

- Proof of concept of the tropical orbit is done and positive:
research precipitation estimation
operational numerical weather forecasts
- The mission is ageing. NRT stream in discussion. Review next year.
- Constellation based products exhibit physically sound extreme sensitivity to surface temperature
- Large basin hydrology benefits from satellite estimation (and uncertainty)
- TAPEER2.0 based on GPROF and PRPS shows promise over difficult regions.
- Sensitivity to the configuration of the constellation in progress.
- Follow up with C2OMODO?

And remember, use this reference !

Roca et al, 2015 The Megha-Tropiques mission: a review after three years in orbit, Front. Earth Sci., 3, 1–14, doi:10.3389/feart.2015.00017, 2015.